

Odonata from the Tibesti Mountains and the Ounianga Lakes in Chad, with notes on *Hemianax ephippiger* accumulating in the desert

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Abstract. Fourteen species of Odonata were collected in Ounianga and Tibesti (Chad, Africa) in March 2014. Among them, only one zygopteran (*Ischnura saharensis*, with a Saharan distribution), one gomphid (the eremian *Paragomphus sinaiticus*), and two aeshnids (*Anax imperator* and *Hemianax ephippiger*) were present. The latter species was not only the most common dragonfly, but also the most abundant insect seen in the desert. It is likely that it was in a phase of accumulating individuals, possibly as a prelude to another massive trans-Sahara and even trans-Mediterranean migration, for which the species is well-known. The 10 libellulids recorded were almost all Afrotropical species, but several expand to the Maghreb and even Mediterranean Europe. Only *Orthetrum* cf. *hintzi* is a tropical African species that had never been recorded from the desert before.

Key words. Dragonfly, Africa, migration, *Orthetrum* cf. *hintzi*, Sahara

Introduction

Almost entirely situated in the desert lands of northern Chad, the Tibesti mountains constitute an area of almost 100,000 km² of Palaeozoic sandstone mixed with enormous amounts of eruptive rocks. Volcanic activity started in the Oligocene and, in residual form, continues to the present. Several volcanoes peak at elevations well over 3,000 m and include the highest mountains of the Sahara desert. Adjacent to the east is the Ounianga Plateau, well known for its series of large lakes of varying salinity, and further to the south-east lies the Ennedi, an area of deeply dissected plateaux. The Tibesti too has been deeply dissected into a series of deep canyons by water erosion. In spite of being extremely dry, with average precipitation less

than 20 mm y^{-1} in most places, water still flows intermittently through these canyons, and some of them, situated in well-sheltered places, may conserve water perennially in pools known as gueltas. Gueltas may or may not be fed by springs. If permanent, they usually are home to relict populations of fish, amphibians, and sometimes aquatic reptiles. Their invertebrate fauna is only known fragmentarily.

The Tibesti Mountains constitute the last blank spot in our knowledge of the Odonata of the Sahara, and possibly of Africa. Only NAVÁS (1936) published a list of six species collected by the expedition of Marius Dalloni in 1930–31. It also seems that the British scientist K.M. Guichard travelled in the Tibesti and collected a few Odonata, one of which was *Orthetrum ransonnetii*, discussed by LONGFIELD (1955). It came from Mare de Zoui (loc. 9 of the present paper), erroneously spelled Ziou by DUMONT (1978). About the plateau of Ennedi and the lake district of Ounianga, situated south-east of the Tibesti, more is known, with papers by BUCHHOLZ (1959) and DUMONT & VERSCHUREN (2005). Even further east, in the Darfur zone of the Sudanese Republic, there exist papers about Jebel Marra (HAPPOLD 1966) and about the Meidob Hills by DUMONT (1988b). Towards the west, the closest mountains are the Aïr, about which studies are available by FRASER (1950) and DUMONT (1978).

Here, I report on the dragonflies seen and, where possible, collected during an expedition to the Tibesti Mountains and the Ounianga Lakes in northern Chad in March 2014.

Material and methods

The expedition was composed of seven scientists in three four-wheel drive cars, departing from the oasis of Faya Largeau on 04-iii-2014, at first traveling north towards the lakes of the Ounianga plateau, then turning west to reach the Tibesti at Gouro, penetrating the mountain zone in a broad arc around the Emi Koussi volcano, reaching Yebbi Bou, continuing to Bardai and ‘Trou au Natron’, leaving the mountains via Zouarké in the South, and returning to Faya on 18-iii-2014.

Visual observations were made at each vehicle-stop, about five times per day or more. Voucher specimens were collected by netting, but a good pro-

portion of identifications were done on living individuals in the field, or from photographs. Larvae and exuviae were also collected.

List of collecting localities

Ounianga Plateau

Loc. 1. Freshwater springs around saline Lake Yoa, Ounianga Kebir, 19°77'N, 20°29'40"E, 05-iii-2014

Loc. 2. Lake Bokou (freshwater lake), Ounianga Serir, with fringe of reed, 18°54'54"N, 20°29'46"E, 06-iii-2014 (Fig. 1)

Loc. 3. Lake Iguiidi, Ounianga Serir, 18°55'08"N, 20°52'18"E, 06-iii-2014

Loc. 4. Lake Ehou (freshwater lake), 18°59'05"N, 22°53'29"E, 350 m a.s.l., 06-iii-2014

Loc. 5. Shallow, slightly saline swamp at western tip of Lake Iguiidi, with reed and *Utricularia* sp., 18°59'33"N, 29°51'01"E, 06-iii-2014 (Fig. 2)



Figure 1. Lake Bokou, the main freshwater lake of the Ounianga Serir group, northern Chad (06-iii-2014; photograph by Jo Vermeir).

Tibesti mountains

Loc. 6. Outflow of thermal spring at Gouro, 19°33'48"N, 19°35'36"E, 07-iii-2014

Loc. 7. Oasis and river in canyon of Yebbi Bou, 20°55'30"N, 18°05'24"E, 09-iii-2014

Loc. 8. Small oasis with springs and small puddle, overgrown with *Myriophyllum* sp. and other water plants at Timi Troma, just west of Yebbi Bou in the direction of Bardai, 20°57'24"N, 18°04'30"E, 10-iii-2014 (Fig. 3)

Loc. 9. Zoui, mare de Zoui (more correctly named 'mare de Bordosi'), richly grown with *Chara* sp., 21°19'46"N, 17°04'30"E, 11-iii-2014

Loc. 10. Trou au Natron, 20°56'24"N, 16°34'05"E, 2,350 m a.s.l., 12-iii-2014

Loc. 11. Series of gueltas in canyon north of Zouarké, with Blackstripe Barb *Barbus macrops*, 20°26'54"N, 16°14'07"E, 13-iii-2014 (Fig. 4)

Loc. 12. Long series of gueltas in canyon and side-canyons of Oued Douar at Totous, with fish, 19°26'38"N, 17°31'51"E, 14–15-iii-2014



Figure 2. Slightly saline swamp at the western end of Lake Iguidi, Ounianga Serir, northern Chad, the site where *Orthetrum* cf. *hintzi* was recorded (06-iii-2014; photograph by Jo Vermeir).



Figure 3. Pool formed by the outflow of freshwater spring Timi Trona near Yebbi Bou, northern Chad, the only site where *Ischnura saharensis* was found (10-iii-2014; photograph by Anton Brancelj).



Figure 4. Guelta of Zouarké, south flank of Tibesti mountains, northern Chad, site where *Paragomphus sinaiticus* was collected (13-iii-2014; photograph by Jo Vermeir).

Results

Altogether, 14 species of Odonata were recorded during this expedition.

Species list

Ichnura saharensis Aguesse, 1958: loc. 8, 3 ♂, 1 ♀

Anax imperator Leach, 1815: loc. 7 (exuviae)

Hemianax ephippiger (Burmeister, 1839): The species was recorded, sometimes in numbers, at each stop, regardless of altitude and presence of water, although more individuals were seen in oueds with vegetation than over barren plateaux

Paragomphus sinaiticus (Morton, 1929): loc. 11, exuviae, teneral ♂, adult ♂ (Fig. 5)

Crocothemis erythraea (Brullé, 1832): loc. 6, 7

Crocothemis sanguinolenta (Burmeister, 1839): loc. 1

Diplacodes lefebvrii (Rambur, 1842): loc. 2, 4

Orthetrum chrysostigma (Burmeister, 1839): loc. 8, 9

Orthetrum cf. *hintzi* Schmidt, 1951 (Fig. 6): loc. 5

Orthetrum ransonnetii (Brauer, 1865): loc. 7, 9

Orthetrum sabina (Drury, 1773): loc. 1, 6

Trithemis annulata (Palisot de Beauvois, 1805): loc. 6

Trithemis arteriosa (Burmeister, 1839): loc. 1, 2, 3, 4, 6, 7, 8 (larvae), 11

Trithemis kirbyi Selys, 1891: loc. 9, 11



Figure 5. Male of *Paragomphus sinaiticus*, caught freshly emerged at a guelta in a canyon north of Zouarké, south flank of Tibesti mountains, northern Chad, on 13-iii-2014, photographed two days later.

Discussion

The species list is composed of three desert species (*Ischnura saharensis*, *Paragomphus sinaiticus*, and *Orthetrum ransonnetii*), one oriental element (*O. sabina*), a wide-ranging migrant (*Hemianax ephippiger*), and nine Afro-tropical species, of which most advance further north, penetrating Mediterranean and even Western Europe. One (*O. cf. hintzi*) is here recorded for the first time north of the true Afrotropical region, well within the 'Palearctic' desert, albeit based on a single teneral male specimen, still lacking all black markings. It clearly belonged to the *machadoi* subgroup A of LONGFIELD (1955) and was identified to species on account of its small size (total length 35 mm). Further support, at least for the species group to which it belongs, was given by its peculiar hamuli with very heavy OH, slanted posteriad and

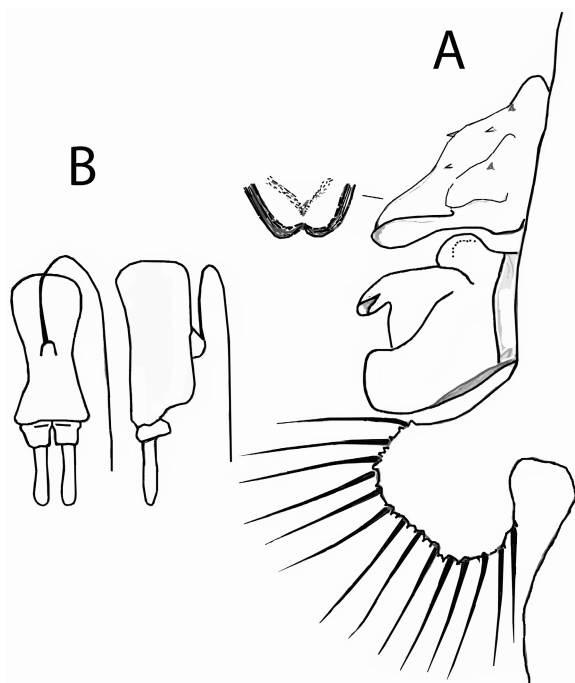


Figure 6. *Orthetrum cf. hintzi*, details of a teneral male collected on 06-iii-2014 at a swamp at the western tip of Lake Iguidi, northern Chad (in the background of Fig. 2); (A) accessory genitalia; (B) vesica spermalis in ventral and lateral view.

with inturned apical margin, lamina smallish, almost naked and slightly bifid at apex, and vesica spermalis with simple unbranched alae (Fig. 6). I compared it with conspecific specimens in my collection from various parts of Africa (Mbalmayo, Cameroon; Bamako, Mali; and Luwingu, N. Zambia), partly identified and donated to me by the late Elliot Pinhey, and found that all varied in size between 36 and 38 mm. In contrast, all my specimens of the related *O. icteromelan* and *O. machadoi* measured 40 mm or more, but had hamuli that looked similar, allowing for individual distortion of the IH and OH by pressure of the vesica spermalis. *Orthetrum hintzi* is widespread across tropical Africa (PINHEY 1970), but the station nearest to Ounianga seems to be Bangui area in the Central African Republic (PINHEY 1971). In Siwa oasis, northern Egypt, a related species, *O. machadoi* (illustrated by photographs of living animals but not by structural characters), was recently recorded by DIJKSTRA & BOUDOT (2010). Possibly, both records refer to the same species, but possibly both are related but distinct and both have outposts in the Palearctic. More material from Ounianga would of course be welcome, for an in-depth re-examination of all species of the *O. machadoi*-group. A characterization using barcoding evidence is long overdue! It is to be noted that in case of synonymy, *hintzi* will take precedence over *machadoi*. Fish were present in the Iguidi swamp, indicating that it is permanently flooded, and that the larvae of *O. cf. hintzi* are capable of co-existing with fish. The individuals of *Diplacodes lefebvreii*, which co-occurred with *O. cf. hintzi*, were also immature, suggesting that the dragonfly season was only beginning. The same was true for *Paragomphus sinaiticus* (Fig. 5), a species locally common in South Arabia and previously known in the Sahara from a single isolated population in the Aïr, Niger, only (DUMONT 1978). The present record represents a considerable range extension towards the East of a species that is known in Africa only from a few widely isolated colonies.

NAVÁS (1936) assigned a single specimen of *Trithemis kirbyi* collected between Bardai and Yebbi Bou to a new »variety« he called *dalloni*, said to have reduced orange markings on the wings. A male captured at Zouarké and one observed and photographed at Yebbi Bou, however, showed markings of the usual extension for African specimens, and we consequently consider Navás' variety as an individual variant, not a subspecies.

The paucity of zygopterans was striking, with no *Pseudagrion* seen at all, although *P. hamoni* has been found in the adjacent Ennedi gueltas (DUMONT & VERSCHUREN 2005). This may, again, be a seasonal effect. The one species seen, *I. saharensis*, is an indicator species of the Sahara. It is found in all parts of the desert, including the Aïr (DUMONT 1978), but had not been recorded from Chad. It is currently the only zygopteran species known from the Tibesti. The geographically closest population is in the mosquito oasis of Oua en Namus in Libya (AGUESSE 1958). In the Ennedi and at Ounianga, the related *Ischnura senegalensis* has been recorded (DUMONT & VERSCHUREN 2005), and also in the Meidob hills and Jebel Marra in Sudan (HAPPOLD 1966; DUMONT 1988a), so that the Tibesti might be the limit of south-eastern extent of *I. saharensis*. It should be noted that in eastern Africa, both species have not been found to co-inhabit a single biotope. In western Africa, in contrast, sympatry has been noted in two desert localities in Mauretania (DURANT & RENOULT 2012). This might relate to the fact that the western Sahara is far more humid than the eastern Sahara, facilitating dispersal on tiny Zygoptera.

No doubt the most conspicuous and abundant dragonfly seen in Borkou, Ounianga, and Tibesti was *Hemianax ephippiger*; of the other aeshnid recorded, *Anax imperator*, only a single exuviae was collected at Yebbi Bou. It was spotted at every stop during the whole duration of the expedition, usually within a few seconds to a few minutes of observation, and often in numbers, at elevations varying between less than 300 and 2,350 m a.s.l. The dragonflies were hunting mostly among sparse vegetation of *Acacia* and *Calotropis* trees, but occasionally were seen flying in rocky environments. As is typical for the species (PINHEY 1951), and unlike true *Anax*, these sexually immature individuals were non-territorial and tolerated each others' company quite well. The total number of individuals in the Tibesti is hard to estimate, but must have been enormous. We saw no evidence of migration, and no clear gradients in abundance, except that more individuals were seen in vegetated oueds than on barren plateaux. Voucher specimens of both sexes that were collected were neither teneral nor fully mature. Especially the blue 'saddle' at the top of the abdomen was lightly coloured. The only fully coloured individual observed was a female that attempted to lay eggs in a small weedy puddle near Yebbi Bou (Fig. 3).

The question arises what could be the origin of these millions of *H. ephippiger* and what will be their fate. Episodic mass migrations in this species are well documented, with large numbers crossing the Mediterranean and dispersing across Europe (DUMONT & DESMET 1990). Since GAMBLES (1960) we know that *H. ephippiger* is capable of rapid larval development (70–120 days or less, depending on the temperature; CORBET 1999; STERNBERG 2000) and of a long adult life, perhaps up to a year; that is the reverse situation to that found in most other dragonfly species. Migratory *H. ephippiger* seen in Mauretania and northern Mali may therefore well have their larval origin in the monsoon-flooded waters of northern Nigeria. For the animals in Ounianga and Tibesti in March, the larval habitat could well be situated in southern Chad, between 8° and 14°N. If these larvae emerge starting December, and engage in a slow movement north, they should be spending early spring in the southern Sahara where we spotted them, and may possibly reach the Mediterranean by April–May, postponing colour and sexual maturity until May–June. Some individuals do, however, mature earlier and oviposit in any place where suitable sites are found, like that we saw in Yebbi Bou. This system of migratory activity is probably almost yearly, or at least occurs after each good monsoon season, and is maintained by animals that either do not leave their area of origin or come from other regions. The emigrants, in contrast, attempt to expand the range of the species, and with the warming of the European climate, result in more and more sightings in that continent (BURBACH & WINTERHOLLER 1997; PARR 2011; LAMBRET & DESCHAMPS 2013). It follows that the *H. ephippiger* seen in Europe have a long life behind them, have crossed thousands of kilometers, including the biggest desert in the world, and, although aquatic, have been the most conspicuous insect in that desert during our expedition!

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the picture of *Paragomphus sinaiticus*. Thomas Schneider attracted my attention to the record of *Orthetrum machadoi* from Siwa, Egypt, and confirmed its presence there from his own unpublished observations. Additions and corrections by the reviewers of this paper, Jean-Pierre Boudot and Graham S. Vick, greatly improved the draft version. Special thanks to the King Leopold III foundation of Belgium for generous support to my trip.

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